

Customer Involvement in the Design Phase of Construction

A Scholarly Paper Presented to

The Faculty of the Construction Engineering and Management Program

University of Maryland at College Park

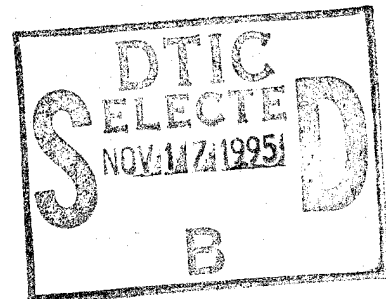
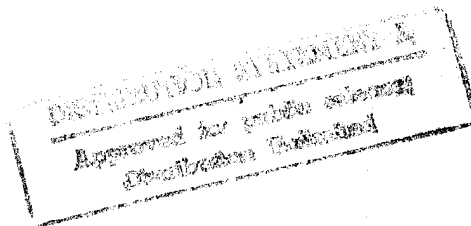
by

Thomas B. Tryon

In Partial Fulfillment

of the Requirements for the Degree of

Master of Science (in Civil Engineering)



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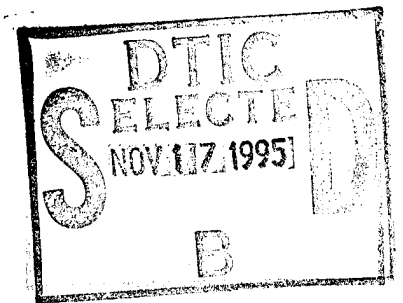
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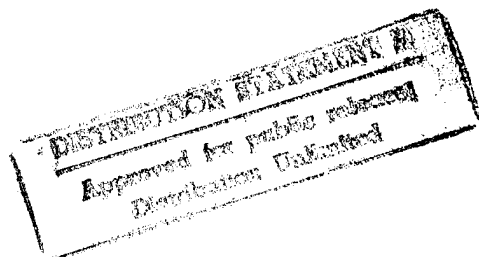
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Abstract

The principals and tools of Total Quality Management (TQM) have gradually made their way into the construction process as a whole. Various phases of the process, mostly large size projects, have experimented with TQM tools, team building, and customer involvement and have found success. Here, the intention is to present the reasons for this success and discuss how they may be applied to smaller projects which are found at the Public Works level of a Naval Base.

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Literature Review

After reviewing Mr. Bröchner's work on construction process models, this became the basis or guide to the development this paper. The main items which can be related to are the emphasis which should be placed upon getting the customer involved in an interactive manner. The other is the establishment of a model or guide to the process of customer involvement and the use of Total Quality Management (TQM) principals and tools for it's continuous improvement.

Other areas that this article discusses that are directly related to this paper are that currently there is lack of established models or programs for the traditional "craft-type" construction. Any work which has been done in the field of construction is more related to "industrial type" (refineries, power plants, etc.) construction. It also places emphasis on the one time customer which will construct a building or renovate an existing one. The manner in which an Architect and Engineering (A/E) firm gets the customer to relate their primary needs to that of the construction process is the key to improving the customer's overall role in this process.

Mr. Bröchner delves into the customer relationship through the entire construction process. There also exists a relationship here to that of this paper, were the discussion of public sector procurement takes place. The problem of a hierarchy is emphasized and how it degrades upon the entire process, particularly the design phase. This topic has been developed in this paper and is seen as a key reason for the utilization of TQM tools by the customer to grasp exactly what they want in terms of a final product from this project.

The article addresses the current existence of models in the construction industry. Once again the lack of models which exists for the "craft-type" construction is emphasized. There is minimal discussion on some models which exist and how they may come to be useful but there is none which address the customer involvement

during the planning and design phases, which is the emphasis of this paper.

The next article, which was written by Mr. Parfitt and Mr. Sanvido, is used to show the successful project results which can be expected when utilizing a specific program or model as a guide to the building process. This article discusses the results of a number of examinations of key areas in the construction process that must be present for the success of a project. The authors have come to define four factors, with specific items to follow under each one, which are to be considered in producing a successful project. These factors are ones which must be considered by all individuals involved, particularly as a team, prior to the commencement of any construction. Emphasis is placed during the planning and design phases of the process. As stated previously this is the basis for this paper, and these factors are displayed in a manner to emphasize the importance of their consideration by the team. These factors comprise a checklist which should be utilized and tailored for use by the Public Works organization in their interaction with the customer and the A/E firm in a team setting. At a minimum these factors must be considered and in doing so should produce an environment for the most productive efforts from the team.

An article by Mr. Burati, Mr. Matthews, and Mr. Kalidindi was also valued for inclusion in this paper. The article discusses the principals and elements of TQM from a construction standpoint. Emphasis is placed upon their implementation into the construction process and how they should be used to promote customer involvement and satisfaction along with continuous improvement.

The article details the steps which must be considered and taken to establish a TQM setting by an organization. It calls for the inclusion of all the customers, both internal and external, and their roles in the TQM process.

The final paragraph addresses whether or not this type of process can be applied to construction in the United States. Success has been achieved by construction

companies in Japan. Even though the construction process differs significantly in Japan than that found in the U. S., it is believed that the construction industry can develop TQM into a success similar to how the manufacturing industry has done.

The relevance to this paper lies in the development of TQM into the construction process. This article discusses procedures for how to implement TQM which is a focal point of this paper but which is more directed towards the planning and design phases of the construction process. The TQM principals and elements, customer involvement and satisfaction, continuous improvement, training, teamwork, and feedback are all inherent to this paper.

Mr. Albanese has written an article with a similar emphasis as the article that was discussed previously. This article though, focuses specifically on the team-building process. Research was done by Mr. Albanese on the effects of a team setting between the owner, the A/E firm, the contractor, and others, in some cases, during a construction project. The findings were supportive of a team orientation during this phase. The manner of how to initiate and foster this setting was detailed for the reader, discussing the benefits but also noting some of the problems. These problems mostly related to getting all parties to buy into the concept without any reservations.

The relation to this paper is that of team building and the success that can be achieved when it is utilized. When used in the setting of planning and design though there should be less obstacles since it is not the adversarial relationship that is frequently seen between owner and contractor.

For this paper a few books have been used as references. Customer-Driven Project Management by Barkley and Saylor gives a thorough presentation of TQM material and then demonstrates it's role in the area of project management. It discusses topics that touch on understanding the process from all perspectives, improvement methodology, TQM environment, Customer-Driven Project Management

(CPDM) tools and techniques, and customer driven teams (CDTs). The presentation of the materials on team, tools, and techniques are considered to have the most relevance to the concept which is being presented in this paper. This is the basis for the success of the planning and design phases which is discussed. This book should be used as a guide for the approach to take when establishing a team setting and utilizing TQM tools and techniques to better a process. It's emphasis on the customer, along with the importance which is placed on front-end analysis ties this book very closely to the drive and goals of this paper.

Another resourceful book which exhibits a TQM tone is Business Process Improvement by H. James Harrington. This book provides a manner in which organizations can complete analysis on the various processes they have so they can make improvements for their customers. It discusses how this improvement process should be established and set up in an organization. Flowcharting is utilized as the main tool for improvement and a discussion on how to analyze and improve the process is provided. Information on measurement, feedback, and benchmarking are provided as well.

Value can be found in the particular manner in which the author discusses and illustrates the use of flowcharting to analyze a process. This can be specifically applied to the overall process which Public Works is involved in with the customer. The detail provided in this will be of great value to the customer. It will also allow a time evaluation to take place on the process.

Other articles and books which have been mentioned in this paper but do not have a specific relation to the topic matter have been listed in the Reference section of the Appendix.

Introduction

The continued integration of Total Quality Management (TQM) into to all areas of business has established the betterment of processes for the customer(s). Team building concepts with customer involvement are becoming a common manner in which to continually improve the process(es) which the customer has come to depend upon. Improvements in time, quality, and cost can be attributed to this effective interaction (Barkley and Saylor 1994).

This paper, in the general sense, is written to illustrate the value of the customer to the total process. The process in this case is the planning and design phases of a construction project, which is developed by a Navy Public Works Organization. The current process that exists will first be discussed. The relevance of a thorough upfront effort in the total construction process will then be demonstrated by stating and discussing four factors that have been established for a successful project (Parifitt and Sanvido 1993). This will then be followed by a discussion of TQM principals and tools that can be utilized to foster this team concept and the continued improvement of the process.

A number of articles from books and journals were evaluated for relevance to this topic which was first derived from an article by Bröncher (1994). They were reviewed for discussion on customer involvement in the construction process, implementation of a team concept, and the utilization of TQM principals and tools.

These smaller projects which are developed at the local Public Works Department level, are usually done so with less resources and less experience. Even with the efforts of those involved maximized, the end product is not as functional as it can be. When the contracts come to be administered under construction they tend to involve a project managers time in a non-linear relation to their higher cost, multi-million dollar projects. That is even though the dollar value is small the time spent in administrating

the contract is similar to the higher dollar value contracts. This in part can also be attributed to the smaller, less experienced contractor which often obtains these contracts. These factors exemplify the attention to detail which must be placed upon the planning and design phases of these smaller sized construction projects. This attention, this focus can best be maximized through a team concept between Public Works, the A/E , and most importantly the customer. This team's ability to interact and set and pursue goals is of most importance and can be assisted through TQM principals and tools.

Background

Public Works has the role of developing the plans and specifications for the various activities on a base. The dollar value of this construction may range from \$25,000 to \$500,000. The design can either be completed in-house by Public Works' architects and engineers or can be contracted out to an A/E firm. In both situations the interaction with the customer is the same. Usually the customer will submit a request for a project to be completed. This will be the initial contact of the two groups. The customer must then do their best to illustrate to Public Works what exactly their needs and wants are. Experience has shown that there are no formal tools available to the customer to effectively interact with Public Works at a respectable level of competency.

Once the information is provided, it is developed into contract documents (plans and specifications) either by Public Works or an A/E. Then the routine of reviewing the documents at the various stages (35%, 90%, 100%, and final reviews) takes place by all parties involved (Public Works Engineering, Customer, Resident Officer in Charge of Construction-ROICC, and Fire Department). Through these reviews the party will list the questions or the deficiencies found in the documents and then submit back to the A/E through the Public Works organization. During these review sessions there is a loss of contact between the customer and the A/E firm and the Public Works

organization. The interaction has been reduced to what is written and exchanged through the "channels". There is no team concept in this interaction, there is no unity or a common goal. For a successful project though, more attention must be placed on goals. A vital step in achieving this is for all parties involved to have a common project mission (Albanese 1994).

Success Factors

These two main areas of interaction, initial contact and review stages, have been determined through actual testing to be a critical item in the success of a construction project. Parfitt and Sanvido (1993) have developed a Critical Success Factor Checklist which was arrived at after studying the impact of a certain list of items on project performance. From this study four major factors emerged. From these four each one was broken down to consist of four to fifteen individual statements that better characterized the factor. All four of these factors emphasize actions or goals which need to be taken or met during the planning and design phases of the construction project.

The first of these factors deals directly with the development of a "Facility Team". This team would have a standard make up of the customer, the Public Works organization, and the A/E firm. Others could be added as is determined necessary. In the team setting it is of paramount importance to have a continuously flowing line of communication. This will be a requirement for all parties. The customer must be prepared, through prior intraorganizational interaction, with a general ideal of what the project design should include. As well the Public Works organization and the A/E firm must come prepared to exercise their experience in retrieving pertinent information from the customer.

An item of additional value is to have a set of team building activities in place to help in the initial dialogue between all the team members. This will help all members

by initiating them to one another, with the most assistance going to the customer, who will come to this team with the least experience, both in terms of design and construction and in the team interaction process. This cooperative relationship will assist the team in establishing, working towards, and achieving a set of project goals. These goals all too often are not covered during this stage of design. TQM tools and the team atmosphere will foster this development and provide a focus that will guide the team to their goals.

Another item in this first factor are the determining of the level of quality expected from the customer. This level of quality may pertain to the workmanship provided by the contractor, the continuing interaction and information flow to the customer, the number of change orders and associated dollars spent towards them, the life cycle of equipment to be installed, or the color schemes that are present at the end of the project. These and many more quality issues will need to be addressed in this initial interaction so that the efforts of the A/E firm in the design can appropriately address each one. At this same time the Public Works organization needs to establish its own level of quality on issues that the customer has no knowledge of. These may include the type of equipment to be installed and whether or not their shops are qualified to work on it, the availability of parts, or the past record of similar equipment. All this information will need to be available for discussion and understanding by the team.

The next factor in the list of four is "Contracts, Changes, and Obligations". This again pertains to items which must take place and be determined prior to the commencement of construction. Now the contract documents are evaluated just prior to them going out to bid. Upon the final review of documents, the first item of consideration is whether or not they reflect previously set goals and objectives in a clear, concise manner as close as legally possible. The government has a legal responsibility to the contractor to provide contract documents free of ambiguities. The

contractor(s) should not have to make assumptions in completing their bids and later in the work (Sweet 1994). This is therefore a very important consideration.

This can be seen as one of the final evaluations by the team in determining the conciseness of the documents. The goal is to provide a set of documents that will one lead to a competitively bid project that comes in on budget and two, that will reduce the ambiguities and possibility of change orders. Another time for evaluations will be at the end of the bidding process and later at the end of the project. This feedback is most important to the team. Further discussion on the importance of feedback will be provided later in this paper.

Also discussed under this factor is the importance of contingency plans. As is possible in any type of project or contract relationship there are some uncertainties that may not be able to be totally addressed in the preliminary stages. There is no reason though to not have a plan formulated for those items that are seen as having the potential for uncertainty. This will allow for a faster more confident resolution process with the goal of minimizing the impact to the entire project. A major contingency item that definitely needs to be addressed in the early stages of any project is that of time delays. Many follow-on activities get scheduled based upon the original completion date of a project. Having a plan of action as the project progresses can be an asset towards the project end.

Another, just as important item that should have a contingency plan established for, is money. This is an item that is of critical importance for many reasons in the federal procurement system. The first concern with money is usually whether there appears to be enough of it to complete the project at the level of quality that is expected of the customer. Most projects have dollar amounts attached to them that can not be exceeded without approval from an authority above that of the Commanding Officer. To avoid exceeding these funding limits it is advised to have a previously thought out

plan that will address both this situation and that of others.

Along the lines of a contingency plan is the need for systematic manner in which to monitor these specific items to determine when certain, previously determined, actions should take place. This is a situation that may warrant the use of a TQM tool, the responsibility matrix (GOAL/QPC) . A matrix can be generated in relation to each contingency item. This matrix would highlight the action to be taken by each team member when it was determined that the plan needed to be initiated. Also included in this should be a time frame for its implementation.

The third factor in this checklist, "Facility Experience", is one that requires upfront consideration prior to the team being determined. This would first require the evaluation of the members of the Public Works organization with the goal being to find a personnel match to the work that is going to take place. As the factor title states, experience is the top characteristic that should be considered. In the customer it is unlikely to find the construction experience that will be evaluated for in the others. For them it would be beneficial to the team to select someone with prior team-based involvement and who is an advocate of its use. This though should not only be applied in consideration of the customer but also for all involved (Albanese 1994). The Public Works organization has the responsibility of evaluating the experience of the A/E firm through the Slate and Selection process. Here a group of A/Es are interviewed during a presentation which is given to a board of three to four members. Here it is of value to have the customer and the specific project(s) in mind when evaluating. This is not always possible but should be considered when it is.

The fourth and final factor in the Critical Success Factor Checklist is "Optimization Information". This factor as well has it's roots established prior to the commencement of any construction. It asks of the team to review the design of the facility to verify if the design has been optimized in relation to everyone's personal expertise, in respect to

the design and operation of other facilities, in regards to the constructability of the various building systems, and in the communication of this information to the entire project team and its inclusion in the contract documents.

These factors and subsequent checklist, exemplify the importance of the time and consideration that must be taken in the initial phases (planning and design) of a project to have it being a successful one. This is a starting point which can be used by the Public Works organization in preparing a model for the interaction and development of the contract documents. Through TQM and continuous improvement this checklist can be supplemented as its use will lead to the increased awareness of what is determined to be critical factors to the success of various projects. It is therefore important to have a post-construction (feedback) meeting with the agenda consisting of the end evaluation of the project. Here the checklist can be reviewed to determine if these items as well as others, which can be added for future checklist, are remaining valid. This list should be used as a guide along with other possible sources to improve the team interaction and goal setting and achievement. An additional post construction evaluation should be completed by the customer at a year's time after the occupancy date. The information from this evaluation should be shared by both the Public Works organization and the ROICC office for the continued improvement of both organization's processes. It is important that this evaluation be executed as scheduled and not disregarded. In the effort of continuous improvement both these organizations need to be provided with this information for the betterment of their processes for improved results for future customers.

TQM and the Team

As the methodology of Total Quality Management (TQM) spreads to all occupations, the customer continues to be the focus for the end product produced.

total satisfaction to the customer. As we have been informed through the TQM philosophy, an integrated effort among personnel at all levels must occur to increase customer satisfaction by continuously improving performance (Burati, Matthews, and Kalidindi 1992). For this to take place an organization must provide extensive training to their personnel so that they have the knowledge and knowhow to continuously improve their services. The training and education should cover a broad spectrum of topics which at a minimum may consist of the following: basic TQM principals, team problem solving, interpersonal communication and interaction, goal setting, and resource planning (Barkley and Saylor 1994; Burati, Matthews, Kalidindi 1992). This training, education, and overall organizational philosophy is also an important aspect to be found in organizations that one interacts with as well as with one's customer. To achieve the best possible interaction with these other organizations it is paramount that they are fully aware of and integrated to the same level of TQM involvement. The quality of any stage in a process is directly related to the quality of the process that is previous to it. This is important to remember when involved in any process not only from the aspect of the customer but also from the standpoint of any external parties or those that are internal to the organization (Burati, Matthews, and Kalidindi 1992).

In the construction industry this may be seen as a difficult undertaking, especially with the customer. The customer's background is usually limited in knowledge of the many phases of a construction project. Therefore the full utilization of TQM principals and tools is needed to assist in escalating the customer's knowledge and interests in the project.

The customer should have exposure to various TQM tools. In the initial stages of the formulation of their own ideals they should utilize these tools to develop a set of ideals and desires that they wish to see accomplished by the completion of this project. Bröchner presents this issue and makes special reference to public sector

procurement. With the hierarchical organization that is in place there is an understandable deviation in the desires and goals that are to be achieved with the undertaking of a project. It is therefore most important for there to be a hierarchical gathering so that there is a consensus throughout the organization as to what is to be the specific purpose(s) of a project. But this should not be an unguided undertaking. This is a situation where a set of guidelines or a model should be prepared by the Public Works organization, which will consist of a list of specific items that the customer should be aware of during the establishing of their desires and goals. An example of items that may appear on this list would be the threshold of funding for the project, the time of execution for the various stages of the project, life cycle principals in the choice of materials, monetary contingencies, etc.

What would be better than providing just a list would be to have a person from the Public Works organization sit in on this development stage and act as a facilitator and a source of information to the entire process for the customer. This could be an important step in the startup of a project.

Contrary to the situation of the customer, there is a selection process for the Architect and Engineer (A/E) firm. During the selection process the TQM tools and principals utilized by the firm can be evaluated, just as it was done for their experience. With an emphasis placed on the utilization of TQM processes, it would only seem a matter of time before these concepts evolve at a firm if they have not already. This is very important to the overall end customer's satisfaction. The A/E firm is to become the next stage in the development process of the plans and specifications. The efforts that have been expended by both the customer and the Public Works organization will be deemphasized and minimized if the A/E firm that is to continue the process is not a user of TQM tools and principals. The ability of the A/E to continue the productive efforts to date, will rely upon their ability to continue to pull

and gather information from the customer. The retrieval of this information must continue as that of which has been done previously to maintain the continuity of the process for the customer. The transformation of all the previous work to the plans and specifications by the A/E is a critical stage in the development of the contract documents. The success of this transformation will depend on how well the A/E can relate to the customer and the information that has been provided to this point. Just as in the beginning when the Public Works organization first came involved with the customer the A/E must develop a full understanding of the customer. This is not just a duty which falls on the A/E. It is the responsibility of all involved to foster and develop this understanding so that the customer's primary process can be properly related and emphasized during the design process and later in the construction process (Bröchner 1995). This is a key area where the utilization of TQM tools can produce the needed understanding.

TQM principals shape the roles of the people involved in any process so that they continuously strive to provide satisfaction to their customer. A proven way to determine the level of quality needed to provide this satisfaction is to have customer involvement in the process. This seems appropriate in any process but in particular in the process of designing a project. As one looks at the time of contact with any project, the customer will by far have the most interaction with the new building, renovated office, etc. It is only fitting then to have them involved in the process that will shape the project for all the years to come, the design process. The customer needs to be fully integrated into this phase of the project. What other way can their needs and desires be determined, implemented, and evaluated in a timely manner? The forum therefore must be set up in a manner to retrieve this information as quickly and efficiently as possible. The forum is a team setting with TQM tools that will foster this development.

When involving the customer in the process it is necessary to educate them first to the process as a whole. This education process will also be of value to the Public Works organization. They will be faced with having to break down the process in a manner so that it is understandable to the novice, first time user. An ideal manner to demonstrate the process along with the time associated would be to utilize flow charts, timelines, or combination of the two. This type of layout will provide the customer with a way to visualize the process better and lead to a better understanding of the role that they must play in it. The Public Works organization will also be able to add this flowcharted process to their list of TQM tools and strive to continuously improve it. In relation to time this process is very consuming. The planning and design phases can consume up to nine months for a \$200,000 to \$500,000 size project. This does not include the 45 to 60 days for advertisement of the project and then the actual time of construction. Improvements to the advertisement and construction times would be minimal. The focus for improvements in time would have to be during the planning and design phases. These two subprocesses, once flowcharted for the customer, can then be possibly reduced through streamlining of the process (Harrington 1991). Flowcharting therefore provides two important values: it provides the customer with a visual aid that can help them better understand the entire construction process and their role in it. It also serves as a TQM tool which can be used for the improvement of the process by the Public Works organization.

This informing the customer of all that is involved in this process should go beyond the discussion of just the various phases of the entire process. It should reach into the pertinent, customer impacting or time impacting issues that may arise throughout the process. This discussion can range from change orders (both unforeseen and customer requested), impact on the customer during the construction process, the inspection process, the turning over of construction documents, and other items that it

would be important for the customer to know.

It is also imperative that all parties are mutually informed of the role and duties of each other. This can be best illustrated through the use of a matrix. A generic matrix model should be initiated and provided by the Public Works organization. It should list the major descriptions of the roles and responsibilities of those involved on the vertical axis of the chart with the participating organizations on the horizontal axis. As the interaction of the parties takes place the matrix can have additional roles and responsibilities added and can continue to be used throughout the process as a valuable source of information.

In providing this generic matrix model the Public Works organization can utilize TQM tools, specifically brainstorming and affinity diagrams (Barkley and Saylor 1994), to establish it. Personnel involved in this process would be expected to draw upon past experiences as well as other documentation that already exists.

In and around this time the customer should as well be introduced to team building skills. The customer's representative(s) will be expected to interact with the Public Works organization and the A/E in a team environment. With the importance of the design at stake these team skills will be emphasized and utilized by all participants to set the design process in motion. The level of detail provided in this stage could very well lay the grounds for a successful end project or it could be the beginning of a problem plagued situation that does not meet the desired outcome of the customer. This design, inclusive of the plans and specifications, will come to represent a major part of the legal contract that will exist between the contractor and the Navy. This effective upfront involvement from all parties will result in the minimization of problems. This upfront, focused approach will also maximize the production of the team, specifically in regards to time.

Conclusion

The concepts and principles of the TQM philosophy appear to be established in the many organizations that are involved in the many phases of the construction process. Organizations should by now realize the importance of the customer focus and continuous improvement of the process(es) that affect them. In the construction process there is no better area to utilize TQM, continuous improvement, and customer involvement than in the planning and design phases. Upfront involvement in a team setting has been proven to lead to successful projects (Parfitt and Sanvido 1993). The forum is set for the improvement of this process, with the groundwork being laid within this paper. Continuation in this area may lead to a more concise universal model that can be utilized by all who undertake this process. As well with the expansion into information technology a computerized format may be developed for all users within the team.

Appendix

References

Albanese, A. (1994). "Team-Building Process: Key to Better Project Results", Journal of Management in Engineering, 8(6), 36-44.

Barkley, B.T. and Saylor, J.H. (1994). Customer-Driven Project Management: a New Paradigm in Total Quality Implementation, New York: McGraw-Hill.

Bröchner, J. (1995). "Construction Process Models for Change", First International Conference on Construction Project Management, Singapore: 67-74.

Burati, J.L., Matthews, M.F., and Kalidindi, S.N. (1992). "Quality Management Organizations and Techniques", Journal of Construction Engineering and Management, 118(1), 112-128.

GOAL/QPC (1993). Seven Management and Planning Tools, Methuen, Massachusetts.

Harrington, H.J. (1991). Business Process Improvement: the Breakthrough Strategy for Total Quality, Productivity, and Competitiveness, New York: McGraw-Hill.

Parfitt, M.K. and Sanvido, V.E. (1993). "Checklist of Critical Success Factors for Building Projects", Journal of Management in Engineering, 9(3), 243-249.

Sweet, J. (1994). Legal Aspects of Architecture, Engineering and the Construction Process, 5th ed., St. Paul, MN: West Publishing Company.